A data glove with tactile feedback for FMRI of virtual reality experiments.

by: Jeonghun Ku, Richard Mraz, Nicole Baker, Konstantine K. Zakzanis, Jang Han H. Lee, In Y. Kim, Sun I. Kim, Simon J. Graham

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Abstract

Virtual reality (VR) technology is increasingly recognized as a useful tool for the assessment and rehabilitation of neurologic and psychiatric disorders. The hope that VR can accurately mimic real-life events is also of great interest in basic neuroscience, to identify the brain activity that underlies complex behavior by combining VR with techniques such as functional magnetic resonance imaging (fMRI). Toward these applications, in this study we designed and validated an fMRI-compatible data glove with a built-in vibratory stimulus device for tactile feedback during VR experiments. A simple VR-fMRI experiment was performed at 3.0 Tesla on four young healthy adults involving touching a virtual object with and without tactile feedback. The usefulness of the data glove was subsequently assessed using a series of questionnaires, behavioral performance, and the resulting activation images. Questionnaire scores indicated positive opinions with respect to the data glove, the tactile feedback, and the experimental paradigm. All subjects felt comfortable in the scanner during the VR experiment and were able to perform all aspects of the tasks successfully and with reasonable accuracy. In addition, activation maps showed the anticipated modulations in motor, somatosensory, and parietal cortex. These results support that tactile feedback enhances the realism of virtual hand-object interactions, and that the tactile data glove is suitable for use in other VR-fMRI research applications (e.g., VR physical therapy for stroke recovery).

Football Passing Aerodynamics

http://www.faqs.org/sports-science/Fo-Ha/Football-Passing-Aerodynamics.html

The basic purpose of a football quarterback when throwing a pass is to throw the ball as accurately as possible to minimize the chance of an interception and, many times, as fast as possible in order to maximize range. When a quarterback releases a well-thrown, tight-spiral pass, many forces are involved in the action. In order to accomplish this so-called perfect pass, the quarterback would be well advised to study the forces experienced by a football moving through the air—what is called aerodynamics.

A football thrown as a pass into the air has inertia; that is, the tendency of an object in motion to remain in motion. However, because of the force of gravity, which pulls the ball down, and the force of air resistance, which slows the ball down, the quarterback must balance the forward momentum that he provides the ball (through the motions of his arm and body) with the rate at which gravity and air resistance pulls and slows it down.

Aerodynamics is involved during the pass because the football will travel further and straighter if it is spinning about its long axis—the axis that is pointing in the direction the ball is being thrown. Thus, quarterbacks throw a football with an overhand or sidearm motion in order to impart a spin onto the ball. When thrown with spin, the ball's angular momentum (movement due to rotation around an axis, a product of mass and angular velocity) points in the direction of its long axis. At the same time, torque (force that causes twisting and turning) due to air drag (wind resistance) is pointing perpendicular to the angular momentum. As the ball travels on its semi-parabolic arc, wind torque produces a small change in the ball's angular momentum, which allows the ball to continue to rotate around its trajectory. Thus, spinning stabilizes the football through angular momentum and torque—allowing it to continue to travel in a tight spiral.

When thrown in this manner, the ball gains an orientation that gives it the smallest possible cross-sectional area against the oncoming air, which causes the least amount of aerodynamic drag. If the ball does not spin properly, air travels excessively under its tip as it descends, causing it to tumble and lose some of its forward momentum due to a greater cross-sectional area being exposed to the wind. However, when the quarterback does throws a pass with the proper amount of spin, the football will travel the maximum amount of distance. In the 2000s, professional quarterbacks in the National Football League (NFL) can throw a football up to about 80 yd (73 m) from a set position.